# Appendix 2. Draft Details for achieving Conservation Measures

## A. Conservation of Key CSO Habitat and Habitat Elements

#### A1. PAC Establishment

- 1.1 When owls are located through protocol surveys (for confirmed *territorial* single or pair of owls; see survey protocol appendix  $XX^1$ ) occupying a certain area, managers should designate a Protected Activity Center (PAC).
- 1.2 A PAC should generally include:
  - a. Approximately 300 acres of contiguous, but not homogenous habitat (Berigan et al. 2012);
  - b. The known or suspected nest stand; and,
  - c. The highest quality nesting and roosting habitat near the known or suspected nest stand.
  - d. The next best available habitat if high quality nesting and roosting habitat is not currently present over at least 250 acres
- 1.3 PACs should be configured to include the most mesic, higher productivity sites available contiguous or adjacent to the known or suspected nest stand, since such areas are most likely to support, in the long term, those forest characteristics known to be essential for nesting and roosting habitat (Underwood et al. 2010). PACs may also include other areas of nesting and roosting habitat (and other forest conditions), even if such areas are outside NRV and not likely to be sustainable over time.

## A2. PAC Modification and Retirement

- 2.1 PAC boundaries should be continuously updated in response to significant changes in the physical environment or new data on owl use and occupancy. When an area of nesting and roosting habitat within a PAC has been rendered unsuitable by a natural disturbance, PAC boundaries should be modified to exclude the degraded area and augmented with other areas of higher-quality habitat, or that have the potential to become nesting/roosting habitat, that are adjacent or very close to the PAC. Additionally, when new owl survey data indicates that resident owls are using different areas than demarcated by the PAC, the PAC's boundaries should be adjusted to include the most heavily-used areas.
  - a. To identify a potential modification of the PAC boundaries, habitat conditions should be evaluated within the home range associated with the PAC (a 1.5-mile radius around activity center).
- 2.2 PAC boundaries may be modified during project planning to facilitate implementing restoration and resilience treatments, provided that the modified PAC contains nesting and roosting habitat of equal or better quality to the original PAC and includes known or suspected nest sites and important roosting sites.
- 2.3 Modified PACs should comport with the principles and numeric benchmarks set forth in the section PAC establishment.

<sup>&</sup>lt;sup>1</sup> Refer to Sierra Nevada Forest Plan Amendment ROD for definitions of occupancy and territoriality

- 2.4 Consider PAC retirement, when: 1) the physical characteristics of a PAC have changed so significantly that continued owl nesting within the PAC is unlikely, or 2) survey data indicate that owls are no longer occupying a PAC
- 2.5 When a natural disturbance alters the physical characteristics of a PAC so significantly that continued owl nesting within the PAC is unlikely, efforts should be made to modify the PAC boundary as described above, or the PAC should be retired, unless post-disturbance survey data indicate that owls continue to occupy the disturbed PAC after the disturbance.
  - a. To determine whether a natural disturbance's impacts on a PAC are so significant as to warrant PAC removal, consider whether:
    - i. Greater than 50% of the PAC exhibited greater than 90% basal area mortality (Jones et al. in Press); OR
    - ii. Less than 100 (?) acres of suitable nesting and roosting habitat remains within the PAC
- 2.6 If a PAC is surveyed according to protocol and the results indicate that owls are no longer occupying the PAC (regardless of cause), the PAC should be retired. Survey results indicating non-occupancy should be based on at least 3 years of surveys within the PAC in accordance with the survey protocol. When a PAC is retired, the PAC and associated Territory return to general forest status, where they may be re-designated at a later date or managed towards larger landscape NRV objectives.

## A3. Management within PACs

- 3.1 The nest structure, tree or snag, is a very important resource in the PAC and it should be protected throughout any treatments.
- 3.2 Prescribed fire and managed wildfire are likely beneficial in PACs when maintained at low (e.g. flame lengths < 4') and moderate (e.g. flame lengths 4-8') intensity, such that overstory conditions are not significantly modified. Low-intensity fire treatments should be prioritized within PACs where reduction of surface and ladder fuel is needed. Implementers should strive to keep burn intensity to low levels in portions of the PAC that provide the highest quality nesting and roosting habitat.
  - a. During prescribed burns, all efforts should be made to protect the nest tree (if known) by raking litter and duff away, building line (excluding tree removal) around the base using a radius away from the tree equal to the tree's height, perhaps even using chainsaws to remove ladder fuel directly in contact with the nest tree.
    - Additionally, protect directly adjacent trees that create significant protection over the nest cavity, particularly large trees, by constructing fire line around tree(s) or lightly backfiring out from the nest
  - b. If the PAC is heavily loaded with ground and ladder fuels and there is concern any planned ignitions will burn too intensely, plan multiple entries. Use spring or wet season burns for the first (and second, if needed) entry to initially reduce fuel loadings.
  - c. Establish and adhere to Mitigating Procedures to minimize impacts to owls, especially if burning during the breeding season:
    - i. If burning during breeding season, prioritize burning in PACs with owls that are not nesting that year
    - ii. When possible, moderate smoke away from nest cavity

- iii. Limit thick patches of ground-level stagnant smoke at night by [need input from additional fire/fuels experts]:
  - 1. Taking topography into account
  - 2. Taking advantage of down canyon winds to move smoke
  - 3. Keeping flame lengths lower near the next structure
  - 4. Minimizing the amount of time fire is burning close to the nest structure
  - 5. Other?
- d. When constructing fire lines, strive to retain all large snags (see section A5 for characteristics of the most valuable snags)
- e. Try to conduct all pre-burning activity (e.g., fire line construction) during the non-breeding season (approximately 15 August 1 March)
- 3.3 Hand treatments that minimally impact stand structure, reduce risk to key habitat, and/or facilitate prescribed fire use should be implemented where appropriate and to maintain or improve habitat quality (e.g. multi-layered structure, diversity of diameter classes, moderate- to high-tree canopy cover).
- 3.4 Treatment of roost trees with semiochemicals to reduce risk of bark beetle infestation may be appropriate during periods of elevated beetle populations in adjacent areas
- 3.5 Mechanical treatments (define) in PACs should be avoided to the greatest extent possible and only implemented under special circumstances when necessary to achieve restoration and resilience goals at the landscape scale. Fire (and accompanying hand treatments) should be considered the primary tool for achieving restoration goals within PACs, and restoration goals should be achieved by locating mechanical treatments outside of PACs whenever possible. Consideration of mechanical treatments within PACs should be guided by:
  - a. Existence of adequate survey information [to be defined, see survey information TBD]
  - b. Development of a PAC prioritization scheme [see below, information TBD]
  - Adherence to a monitoring and adaptive management plan [see chapter XX for recommendations related to monitoring and adaptive management for treatment in PACs, TBD]
- 3.6 Where resilience goals cannot be met with fire alone, landscape level prioritization should indicate which PACs, and areas within PACs, are most appropriate for other types of treatment:
  - a. Develop PAC prioritization scheme based on (to be developed): e.g. landscape/metapopulation position, breeding status, occupancy, connectivity, etc.
  - b. In prioritized PACs, prioritize treatments within PACs so that the highest value, most used, and most resilient stands within PACs are left untreated. Not all areas within PACs have the same utility for or use level by owls (Berrigan et al. 2012) and use information, where available, should also be used to help guide management. Prioritize patches (stands) within PACs for treatment (Lehmkuhl et al. 2015) based on, for example (needs development):
    - i. Where such information exists, areas used most heavily by owls, and those associated with an owl nest should receive a retention emphasis while areas of little to no use may be prioritized for resiliency treatments.

- ii. Patches of habitat located in areas where they are likely unsustainable and have potential for conveying natural disturbances across the landscape in ways that jeopardize large patches of owl habitat (as modeled by disturbance progression models) may be prioritized for treatments.
- iii. Patches may receive higher priority for treatment if there are nearby areas that are more likely to sustain owl habitat and are either currently habitat or likely to become habitat within a short time frame (e.g., 20 years).
- iv. Patches that are not likely to promote successful dispersal between existing home ranges or territory clusters (as indicated by connectivity modeling) may be prioritized for treatments.
- v. Areas that will still retain habitat function after treatment, while still meeting the intended restoration objective, may be prioritized.
- 3.7 Limited operating periods when needed to minimize disturbance to CSO reproduction [see appendix XX for LOP description TBD —not yet developed developing and largely based on existing direction]
  - a. Minimize helicopter flights over nests (and PACs if possible):
    - i. Establish landing zones at least ½ mile away from the nest
    - ii. Avoid flying low or hovering over nests
    - iii. Choose flight paths that avoid nest areas

What resources/information are necessary to increase capacity to use fire in PACs?

A4. Promote Key Owl Habitat At The Territory Scale<sup>2</sup>

- 4.1 Protect and promote areas of high canopy cover that occur in biophysical conditions likely to support and sustain them in the long-term, through targeted restoration treatments in surrounding areas (see NRV sections below)
- 4.2 Generally at least 60% of each occupied territory<sup>3</sup> should be in moderate to high canopy cover conditions (>40% canopy cover from remotely sensed data; Tempel et al. in review), as guided by NRV, landscape context, and owl location information. Canopy cover conditions should vary by territory based on location and configuration, territory density, and biophysical conditions.
  - a. Maintain or promote these moderate and high canopy cover conditions in the most mesic, higher productivity sites available and contiguous or adjacent to the known or suspected nest stand, since such areas are most likely to support, in the long term, those forest characteristics known to be essential for nesting and roosting habitat (Underwood et al. 2010).
  - b. Maintain or promote these conditions in areas likely to provide habitat connectivity within and between PACs
  - c. Maintain and/or promote high canopy cover conditions (> 70% from remotely sensed data) over at least 20% of an occupied territory, (Tempel et al. in review).

<sup>&</sup>lt;sup>2</sup> The Territory, as described here, includes the PAC – it represents the entire 1,000 ac circle (or 800 ac circle) around the activity center, including all acres inside of the PAC

<sup>&</sup>lt;sup>3</sup> Occupied territory is assumed for occupied PAC (unoccupied PAC indicates unoccupied Territory)

What will ongoing work being done by scientists on both resiliency and demography tell us about configuration of these types of habitat at the territory and landscape scales?

How should measures be considered differently in areas historically low canopy cover (East of the crest) or areas with very dense (or overlapping) owl territory dispersion?

## A5. Large Tree and Snag Conservation and Recruitment

- 5.1 Retain and recruit large and old trees and snags, as consistent with the Natural Range of Variation. See section B2 below for more details and information.
  - a. In assessing the value of snags for CSO, consider the following characteristics:
    - i. Moderate signs of decay with large pieces of bark pulling away from the bole that causes safe spaces or pockets for bats & flying squirrels (both owl prey items) to roost or den.
    - ii. Snags with small to large cavities, especially if they are protected by adjacent overhanging canopy.
    - iii. White wash around the base or on the snag, indicating that the snag is currently being used.
    - iv. Snags with large (~5"x3") squared-off oval shaped cavities (typically created by pileated woodpeckers). These cavities may be important resources as potential future nesting structures (decay quickly enlarges these cavities for owls).
    - v. large snags in proximity to perennial water are important to principal spotted owl prey (e.g., flying squirrels)

### A6. Minimize risk of habitat loss associated with altered disturbance regimes.

- 6.1 When preliminary risk-reduction treatments are necessary to move a landscape toward NRV, it is appropriate for managers to implement such treatments, even if they do not fully align with the patterns and stand characteristics expected under NRV. Nonetheless, when such treatments are planned, they should be as consistent with NRV characteristics as possible.
- 6.2 When nesting and roosting habitat within a PAC is at significant risk of degradation or loss from natural disturbances originating outside the PAC (e.g., fire, insect/disease outbreak), risk-reduction treatments outside the PAC should be implemented (Dow et al. 2016).
- 6.3 As possible, fuel breaks and treatment containers outside of the PAC should be located in the lower quality owl habitat (e.g., even-aged stands of smaller trees) to protect the higher quality habitat (e.g., multiple-aged stands of medium and larger trees).
- 6.4 If a PAC is located in or adjacent to an area of high fire hazard and NRV-based management outside the PAC would not be likely to provide protection to important nesting and roosting habitat within the PAC during extreme fire weather conditions, non-NRV fuel treatments -- such as SPLATS and/or shaded fuel-breaks -- may be appropriate to protect habitat within the PAC.
- 6.5 If a PAC is located in or adjacent to an area at high risk of density-induced mortality (due to bark beetles and/or drought) and NRV-based management outside the PAC would not be likely to sufficiently reduce risk to nesting and reducing habitat within the PAC, non-NRV

- density reduction treatments outside the PAC may be appropriate to protect habitat within the PAC.
- 6.6 Where local information on the Future Range of Variation (FRV) is available, and suggests that NRV is not sufficient to reduce risk associated with near future disturbance regimes, treatments to move the area towards FRV may be appropriate



- B. Restoration of Resilient Forest Conditions guided by the Natural Range of Variation
  B1. Increase vegetation heterogeneity to approximate the distribution and pattern of seral stages and canopy-cover classes under NRV.
- 1.1 At the landscape scale (watershed and subwatershed scales: 10,000-250,000 ac) and midscale (hundreds to thousands of acres), manage towards a mix of seral stages and canopy conditions consistent with NRV
  - a. This will generally entail increasing the amount of open canopy habitat (all seral stages) and late seral stand conditions (open or closed canopy), with the end result being a patchy distribution of diverse stand types. See Table 1 in Appendix 3. In planning the size and distribution of seral stage and canopy-cover class representation consider the effects of site conditions (topographic position, soil type, elevation, aspect, and vegetation type) and disturbance regimes (e.g., fire, insects, disease, drought, windthrow, landslides, etc.) (Stine et al. 2014).
  - b. Based the likely patterns of historic forest conditions (*See Table 1 in Appendix 3*), the landscape scale should generally be characterized by a highly variable patchwork of relatively open canopy areas over the majority of the landscape, interspersed with early seral and closed canopy areas, resulting in an overall average canopy cover of 17-49% (Safford and Stevens in review).
- 1.2 At the mid (hundreds to thousands of acres) and stand (tens of acres) scales, manage for within-stand and multi-stand heterogeneity, consistent with site characteristics and the variable influences of natural disturbances. Shape multi-stand heterogeneity towards a pattern of individual trees, clumps of trees, and openings (ICO). ICOs range in size, configuration, and frequency based on NRV (*See Table 2 in Appendix 3;* Lydersen et al. 2013, Kane et al. 2013, 2014).
  - a. In determining the appropriate ICO traits within NRV ranges for a given stand, account for site conditions (topographic position, soil type, elevation, aspect, and vegetation type) and natural disturbance regimes (e.g., fire, insects, disease, drought, windthrow, landslides, etc.). For example, based on fire regimes, openings are likely to be larger and more frequent on low-productivity, dry, south slopes and ridge-tops, and smaller and less frequent in high-productivity, moist, valley bottoms. Ridgetops and south-facing slopes should generally exhibit a higher proportion of trees as single individuals, a smaller proportion of trees as tree clusters, and a smaller number of trees per cluster. The drier portions of the landscape should also support more variable crown separation.
- 1.3 Retain and recruit patches of nesting and roosting habitat on high productivity, mesic sites, where conditions can sustain this habitat in the future, consistent with NRV (e.g. lower slopes, valley bottoms, drainages, riparian areas, swales, on north and east slopes, and sites on more productive soils).
- 1.4 At the stand scale, manage for clump-scale vertical or horizontal structural heterogeneity, with the large clumps (>10 trees) having multiple, overlapping canopy layers formed by large trees or complex structure and/or different aged/sized trees.

How does information on canopy cover differ from different data sources, and how can these be crosswalked/aligned?

## B2. Large Tree and Snag Conservation and Recruitment

- 2.1 Retain and recruit large and old trees and snags, consistent with NRV (see Table 3 in Appendix 3; Collins et al. 2015; Stephens et al. 2015; Meyer 2013, North et al. 2009; Agee 2002; Safford and Stevens 2015; Stephens 2004, Stephens et al. 2007, Dunbar-Irwin and Safford in review). In determining appropriate number of large trees and snags within NRV ranges, consider that low-productivity and dry sites are likely to support fewer large and very large trees and snags than high-productivity and mesic sites.
- 2.2 Where large, old, and structurally complex trees of the highest value for owl nesting and roosting are at high risk due to competition, drought, insects, pathogens, and/or fire, consider varied and heterogeneous treatments to: reduce stand densities around such trees to reduce competitive stress (McDowell et al 2003, Fettig et al 2007, McDowell and Allen 2015), reduce smaller ladder fuels to reduce fire risk, or some combination of the two. Simultaneously promote future development of such large, old, and structurally complex trees elsewhere through similar treatments.
- 2.3 Except in the unusual circumstances where such trees pose a substantial impediment to attaining restoration or resilience goals, all live conifers greater than 35 inches diameter at breast height (dbh) should be retained and protected, as 75% of owl nest trees in conifers<sup>4</sup> have been found in trees greater than 35" dbh (unpublished data), and deficits in trees > 36 inch dbh have been recorded rangewide (see Appendix 1).
  - a. This recommendation should not be construed as a recommendation to remove all or most trees below 35 inches in diameter. Deciding which trees should be removed will be governed by NRV values (see Appendices 1 and 3) and stand-specific structural and compositional goals addressed in other recommendations.
- 2.4 Retain and recruit large snags as consistent with NRV (see table 3 in Appendix 3)
  - a. Snags should be irregularly distributed in clumps and individuals, according to site conditions and natural disturbance dynamics.
  - b. Recruit future large snags through retention of the largest, oldest, and most decadent live trees, consistent with the recommendations described above.
  - c. Remove smaller snags that are in excess of what would be expected under NRV to meet fuels-reduction objectives (Knapp 2015).

#### B3. Stand Density

- 3.1 Reduce tree densities to approximate the range of densities that would have been likely under NRV and are likely to be more sustainable under a changing climate.
  - a. In areas where long-term fire exclusion has resulted in stand densities outside of NRV, this will generally entail reductions in densities across seral stages and canopy-cover classes, emphasizing reductions in small size classes. See Appendices 1 and 3 for guidance on stand density ranges consistent with NRV. In determining appropriate proportions of areas within these ranges, manage toward the low end of the ranges on drier sites and in later seral stages, and toward the high end of the ranges on more mesic sites and in earlier seral stages. The lowest tree densities would occur in open

<sup>&</sup>lt;sup>4</sup> Calculations exclude giant sequoias, as owls generally nest in much larger sequoias, but benchmark includes retention of sequoias

- canopy, late seral stands on low-productivity, dry sites; the highest densities would occur in closed canopy, early and mid-seral stands on high-productivity, mesic sites.
- 3.2 In managing to target tree densities, emphasize the removal of trees in overrepresented size classes (frequently smaller or intermediate classes depending on stand conditions) and the retention of the largest trees within a stand. However, retain a diversity of size and age classes consistent with what would be expected under NRV, with sufficient smaller trees retained to provide for habitat diversity and recruitment of future large trees.
- 3.3 Use Stand Density Index (SDI) as a tool to help guide stand density management, depending on local site conditions and short and long term objectives. See Appendix 3 for examples of how to use SDI to guide treatment for objectives such as managing for late-seral, closed-canopy conditions.

#### B4. Tree Species Composition

- 4.1 Manage tree species composition toward NRV based on site conditions and natural disturbance dynamics.
  - a. This will generally entail retaining and recruiting more shade-intolerant and fire resilient/resistant species (ponderosa pine, sugar pine, Jeffrey pine, and black oak<sup>5</sup>) and removing a higher proportion of shade-intolerant species (white fir, incense cedar, and Douglas fir).
  - b. In the Yellow Pine/Mixed Conifer zone, the overstory of open canopy mid- and late-seral stands, and regeneration in early seral stands, should be dominated by shade-intolerant pine and oak species. However, shade-tolerant species should remain a minor to sub-dominant component in these pine-dominated stands and species diversity should be promoted. Such stands will generally be located on drier sites with a higher natural fire frequency and/or intensity. In closed canopy stands, generally located in mesic areas, a more even mix of the various mixed conifer species (including stands dominated by shade-tolerant species) is appropriate both in the overstory and understory.
- 4.2 At the stand scale, where site conditions indicate that a current mixed-conifer stand was likely a yellow-pine stand under NRV, remove some, but not all, shade-tolerant trees (excluding individuals >45" dbh and other select individuals and groups) to restore the stand to yellow-pine dominance.
- 4.3 Implement appropriate treatments to remove smaller trees and fire-sensitive species that would not have survived under a natural fire regime.

How can we incorporate climate change and projected vegetation shifts into these considerations?

#### B5. Understory

5.1 Restore the composition, pattern, and structure of understory live vegetation and woody debris, consistent with NRV. This will generally entail: increasing the diversity and

<sup>&</sup>lt;sup>5</sup> Sugar pine is partially shade tolerant, and black oak shade tolerance declines over time, with seedlings and saplings exhibiting some shade tolerance, and larger trees exhibiting substantially less shade tolerance (refs)

- abundance of forbs and shrubs in the understory, and reducing the amount and continuity of duff, litter, and woody debris.
- 5.2 Manage the understory of mid and late-seral areas for a patchy distribution of shrubs, forbs, tree regeneration patches, and open areas (bare ground) to increase heterogeneity, reduce fuels continuity, and provide a diversity of owl prey habitat. In some situations, managing the overstory to fall within NRV should result in understory live vegetation composition and pattern within NRV. However, management of understory vegetation and fuels through prescribed burning and other approaches is often required to achieve these understory conditions, especially when overstory treatments result in increased surface fuel loading. See Appendices 1 and 3 for more information on understory and fuel under NRV.
- 5.3 At the stand scale, manage for patches of coarse woody debris and thicker litter layers interspersed with areas of shrubs as well as open areas with only ground vegetation such as forbs and grasses. Preferentially retain logs in the largest size classes.
- 5.4 Manage the distribution and volume of duff, litter, and woody debris towards NRV (Brown et al. 2003) by managing stands towards relatively low levels of surface fuels, relatively low but highly-variable levels of coarse woody debris, and highly variable densities of logs across the landscape (see Appendix 3 for further information).
- 5.5 While there are no current NRV estimates for the historic abundance and distribution of duff and litter, it is widely agreed that due to fire-suppression the current abundance and continuity of duff and litter is far above NRV. Therefore, stands should be managed to significantly reduce the abundance and continuity of duff and litter, keeping in mind site conditions and the variability of natural disturbance regimes (e.g., duff, litter, and small woody debris levels are likely to be more abundant and continuous on more mesic, high-productivity sites). Fire (prescribed and/or managed fire) should be used to manage the distribution and volume of duff and litter, with some pre-fire duff removal around important trees.

What additional information do we have about understory needs of owl prey species, and how can that information be used to inform conservation measures?

### B6. Disturbance Regime

- 6.7 Restore natural disturbance dynamics consistent with NRV to help shape and maintain resilient forests.
  - a. This will generally entail managing for more low and moderate severity fire and less high-severity fire, and less bark beetle- and/or drought- induced tree mortality, but also recognizing that some tree mortality is natural and necessary to produce a supply of snags and downed logs.
- 6.8 Use prescribed fire and managed fire to provide for a mosaic of fire effects, consistent with NRV. Manage for a matrix of low-severity burned areas, intermixed with small-to-moderate sized patches of unburned and moderate-severity burned areas, and dispersed high severity areas. See Appendix 3 for approximate areas and proportions of various fire types.
  - a. To maximize the likelihood that prescribed and managed fire will promote beneficial fire effects, consider basing fire restoration efforts on departures from NRV, as indicated by the Fire Regime Interval Departure (FRID) database or other planning tools. For

- example, areas that are currently most departed from NRV with a high Fire Regime Interval Departure (e.g., FRID condition class 2 or 3), could be targeted for wildfire reintroduction, assuming topography, weather, and fire risk patterns are conducive to achieving this objective (North et al. 2015, Meyer 2015). In comparison, areas that are mildly departed from NRV could be prioritized for prescribed fire in areas where current conditions are more challenging to fire reintroduction (e.g., greater risk to high-valued resources and assets).
- b. Design prescribed fire prescriptions for low and moderate severity, primarily confined to the understory with only occasional torching of single trees or small groups of trees, primarily removing understory vegetation and consuming forest litter and woody debris (Safford and Van der Water 2013). Where feasible, and as informed by NRV and current conditions, include areas of moderate and high severity consistent with the proportions described in Appendix 3.
- c. In known owl territories, high severity patch sizes that exceed approximately 100 acres should be avoided to minimize long-term impacts of spotted owl habitat (Assessment chapter 3).
- 6.9 Design prescribed fires and manage natural ignitions to leave some unburned patches, especially in larger burn units, to provide heterogeneity and refugia for owl prey. Unburned areas should generally occur in topographically protected areas such as stream confluences, lower slopes, benches and headwalls (Camp et al 1997; Mallek et al. 2013; Meyer et al. 2007; Roberts et al. 2015)
- 6.10 When developing desired prescribed fire and managed fire intervals, consider the natural fire return interval (FRI) and fire rotation (see Appendix 3 for examples).
- 6.11 When feasible, consider pre-treatment activities (e.g., rake fuels away from boles of known spotted owl nests/roosts prior to burning) and/or manage a fire's progression to conserve key habitat attributes, such as very large trees or snags, as guided by NRV.
- 6.12 For management of natural ignitions, use Relative Risk inputs in Wildland Fire Decision Support System (WFDSS) such as flame length, National Fire Danger Rating System Burning Index (BI), and Energy Release Components (ERC) for duration of burn season to assess risks to owl habitat in the short and long term. Strive to manage natural ignitions in a way that restores fire as a natural process, produces fire effects consistent with NRV, and protects owl habitat elements that are within NRV.
- 6.13 The seasonal timing of prescribed burns should be variable and planned at the appropriate season to help attain restoration goals for proportional areas of burn severities, gap sizes, and species composition (see Appendix 3 for information). The seasonality of burning should be based on desired outcomes and retention of habitat, and burning under conditions not expected to burn under NRV may be valuable for fuel reduction while retaining valuable habitat. For example, in highly departed forest ecosystems with high fuel loads and high fire hazard, burning at times of higher fuel moistures (such conditions or windows may especially occur during the early season) may better mimic the effects of frequent/low-intensity fire regimes (Knapp et al. 2009). Where fuel conditions are restored and/or other risks are low, the NRV in seasonal timing of fire (i.e. predominantly mid to late summer to early fall burns, with some instances of early burning, particularly in dry years) might be used as a guide.

- 6.14 For spring burns occurring during spotted owl nesting season (March July), mitigate smoke to disperse away from spotted owl nests so as not to have caustic levels of CO accumulate in the nest. Also, keep smoke moving off of the ground at night as much as possible so there are not extensive, stagnant patches of smoke interfering with owl foraging.
- 6.15 Prior to and during fire season, perform risk assessments to assess conditional thresholds under which natural ignitions may be managed to burn within NRV. When naturally-ignited fires burn under such thresholds, strive to manage such fires to facilitate burning intensities and patterns to remain consistent with NRV.
- 6.16 Given the current amount and trajectory of high-severity fire and the likelihood that some high-severity fire will inevitably result from fire managed for predominantly low and moderate severity, no management effort is generally needed to generate more high-severity fire within forested high quality owl habitat.
- 6.17 To the extent practicable, manage non-fire natural disturbances so that those disturbances and the effects of such disturbances remain within NRV. While, restoring vegetation pattern, structure, and composition across large portions of the landscape should result in disturbance dynamics for insects, pathogens, and drought that are within NRV, changing conditions on the landscape may require swift and adaptive response.
  - a. Managing stand densities below the zone of competition driven mortality and managing for mixed species composition and size classes are key preventative measures. In instances where such vegetation management is not sufficient to move non-fire disturbance dynamics toward NRV, consider using the following tools to protect high value trees for owls:
    - i. In the very early stages of outbreak only, consider early silvicultural responses to beetles/pathogens to prevent/reduce mortality from outbreaks in progress. For example, this could include cutting and removing, or debarking green trees prior to beetle flight.
    - ii. Beetle/pheromone lures/traps/ can be successful in limited situations where protection of high value trees is critical<sup>6</sup>.
    - iii. Preventative insecticides may be used to protect high value trees from bark beetle attacks
    - iv. Restoration of focal species disproportionately affected by outbreaks (e.g. Sugar Pine)

How can we address the current levels of high insect-caused mortality in Owl habitat? How can we both respond to occurring mortality and prevent future major mortality in owl habitat?

#### **B7. Post Disturbance Areas**

7.1 When considering whether active restoration is needed in an area affected by a natural disturbance (fire, insects, disease, drought, windthrow, landslides, etc.), evaluate the post-disturbance condition of the landscape (including areas outside of the disturbance perimeter) to ascertain whether the landscape is within or outside NRV in terms of

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<sup>&</sup>lt;sup>6</sup> see Fettig and Hilszczanski (2015) and Fettig (2016) for related information

vegetation pattern, seral stage-diversity, stand structure, species composition, and understory conditions. For NRV reference values, refer to Appendices 1 and 3.

- a. In conducting this evaluation, consider not just the specific area that was affected by the disturbance, but also the landscape context in which the disturbed area is situated (this may be one-and-the-same-thing for landscape-scale disturbances). The need for an active response should be evaluated based on overall conditions at the mid-scale and landscape scale, not the stand scale.
- 7.2 When a post-disturbance landscape is within NRV and the trajectory for habitat development is expected to remain within NRV or move towards FRV, limited or no active management may be warranted. In such instances, only engage in management actions that are intended to keep the development of vegetation pattern, structure, composition, and function on the desired trajectory. The following are examples of management that may be appropriate on post-disturbance landscapes that are within NRV:
  - a. Prescribed fire treatments, to maintain the natural fire regime, fuel loading, and fuel continuity for the area.
  - b. Vegetation monitoring to help to determine successional trajectories under warming climate conditions within post-fire environments.
  - c. Restoration treatments that are part of a larger landscape-scale planning effort, designed to promote conditions that will restore natural fire and other disturbance regimes and promote beneficial fire effects in the future (e.g., fuel treatment containers).
- 7.3 When a post-disturbance landscape is outside NRV and the trajectory for habitat development is for conditions to remain outside NRV, active restoration may be warranted to move the landscape toward NRV (or FRV) and provide for long-term resilience. Treatments should be designed to develop vegetation pattern, structure, composition and processes consistent with NRV based on site conditions within the disturbed area and the landscape in which the disturbed area occurs. Restoration and resilience should generally be guided by the recommendations elsewhere in this document. The following additional recommendations should also be considered (see Appendix 3 for more information):
  - a. Protection of Owl Habitat: In designing post-disturbance restoration and resilience treatments, strive to configure and locate activities in such a way as to preserve the best remaining patches of owl nesting, roosting, and foraging habitat (inside and outside PACs), while simultaneously planning for the desired trajectory of the landscape as a whole.
  - Fuel Treatments: Develop fuel treatments to minimize the risk of subsequent fires burning outside NRV and to facilitate future use of prescribed fire and managed wildfire.
  - c. Retention of Snags: retain individual snags and patches of snags a guided by NRV values (see Appendices 1 and 3), with preference for the largest size class (e.g. > 45" dbh)
  - d. Reforestation: At the stand level, when natural regeneration is not likely to provide the abundance, distribution, and species composition of seedlings within NRV (over XX time scale), consider engaging in active reforestation to move toward NRV based on site conditions and natural disturbance dynamics.

7.4 Occasionally, natural disturbances may be so extreme and the post-disturbance condition so far outside NRV that it will likely take centuries before the landscape can be restored to vegetative and process conditions within NRV (e.g., where mega-fires burn entire watersheds or sub-watersheds at high-severity, leaving contiguous blocks of thousands or tens-of-thousands of acres in early seral conditions). In such instances, develop post-fire restoration assessments and strategies grounded in NRV and resilience principles, but not necessarily tied to the specific recommendations in this Strategy. The goal for such areas should be to increase resilience and move them toward NRV (considering projected future conditions), but it may take many iterations of management intervention and decades – if not centuries – of areas remaining outside NRV.

#### B8. Pace and Scale of restoration

- 8.1 At the Sierra Nevada scale, approximately 184,000-488,000 acres of National Forest System land in the Sierra-Cascade region should be actively managed or burned within NRV every year to approach the acreage burned annually under a natural fire regime (North et al. 2012).
  - a. Management levels significantly above and beyond the 184,000-488,000-acre natural disturbance level are needed in the near future to address the backlog of nearly 3 million acres of fire suppressed land that currently exists (North et al. 2012).
- 8.2 While the goal is extensive restoration towards NRV, and eventually FRV, some constraints may prevent entirely achieving this goal. In such cases, a minimum of at least 40-60% of the area at the landscape-scale must be within NRV at any point in time to effectively influence landscape function and disturbance regimes (Turner et al. 1989, Parisien et al. 2007, 2010, 2011; Fites-Kaufman 2014; Coen et al. 2015).
- 8.3 Use all available tools to move Sierra Nevada forests towards NRV. This will include treatments like mechanical treatments and fire, regulatory and policy mechanisms like MOUs, and collaborations and partnerships.
- 8.4 Based on current conditions, a mix of mechanical treatments and fire will be needed to move landscapes toward NRV while minimizing the risk of severe disturbances that impede landscape restoration.
  - a. Given the limitations on mechanical treatments across the Sierra Nevada (North et al. 2015), prescribed fire and managed fire should be used both in conjunction with mechanical treatment and where mechanical treatment is limited to increase the pace and scale of treatment to reduce the backlog of areas outside NRV and to restore the natural fire regime at a meaningful level.
  - b. Re-introduction of fire as an ecosystem process should be considered as a critical goal in restoration projects, and managers should strive to utilize prescribed fire and managed fire when landscape conditions permit -- i.e., when using fire will contribute to restoration and resilience goals without causing significant risk of severe fires that are outside NRV and counterproductive to NRV-based restoration.
  - c. Where forest structure, densities, or fuel dynamics are far departed from NRV, mechanical treatments should be considered an effective means to reduce stand densities, restore forest structure, and reduce the risk of losing critical nesting and roosting habitat to fire or other disturbances. Mechanical treatments may also be

- needed in minimally departed stands where it is difficult to implement prescribed fire without additional pretreatment either due to resource values and, and/or to increase the pace and scale of treatment toward NRV for the surrounding landscape. Where mechanical treatments are applied, use follow-up fire applications to improve treatment effectiveness and begin the process of restoring a natural fire regime.
- d. To facilitate the reintroduction of fire in areas that are outside NRV, mechanical treatments should be used to establish low-fuel anchor points, from which prescribed and managed fire could be strategically expanded on the landscape.
- 8.5 Prioritize restoration treatments to minimize, as possible, constraints and limitations to effective implementation at a rapid pace and large spatial scale (see prioritization principles, appendix XXX, TBD)



## C. Minimization of key non-habitat threats

### C1. Minimize Barred Owl Threat to CSO

Barred owls, as well as sparred owl hybrids, are currently concentrated in the northern Sierra Nevada on the Lassen, Plumas, and Tahoe National Forests. The presumed early stages of the invasion and relatively restricted distribution in the Sierra Nevada may facilitate management efforts intended to control population effects. Given the apparently profound impacts that barred owls have had on northern spotted owls, we recommend that control measures be implemented as soon as logistically and administratively possible while barred owls still occur at low densities in the Sierra Nevada.

A barred owl management program in the Sierra Nevada for the conservation of the CSO should include the following three components: Inventorying and locating territorial barred owls according to a regional-scale survey design; Removal of territorial barred owls following detection by regional surveys; and Monitoring success at both territory and regional scales following removals.

## 1. Inventory

- 1.1 Effective barred owl management will require the development and implementation of surveys with a high probability of detecting and locating territorial individuals over large spatial scales.
  - a. Conduct surveys intended to locate barred owls serially along a latitudinal gradient with initial efforts focused on the northern Sierra where barred owls occur at their highest density.
  - b. Once a sufficiently high proportion of the barred owls in the northern section are located and subsequently removed (see below), inventory surveys could shift to the next area south, and so forth.
  - c. Call-based surveys should be distributed at a sufficient density and visited enough times per season to ensure a high probability of detecting territorial barred owls. A landscape-scale sampling design could be informed by the size and spatial distribution of barred owl territories in the Pacific Northwest and refined by pilot surveys in the Sierra Nevada. Calling techniques should ensure that territorial spotted owls are also detected to collect baseline information on the co-occurrence of the two species and facilitate the assessment of future effectiveness monitoring.

## 2. Barred Owl Control

- 2.1 While other options for reducing impacts to spotted owls may exist, results from other areas suggest that barred owl removal may be the most effective management approach in the Sierra Nevada. In developing a removal strategy, consider the following:
  - a. Implement barred owl inventory (see above) to locate a sufficient fraction of barred owls for removals.
  - b. Successful control efforts will require an effective outreach and communication program to foster public support and engagement in such an effort

- c. As the vast majority of known barred owls occur in the northern Sierra, and this area likely represents a source of dispersers to the central and southern Sierra, it would make sense to invest the effort and time needed to eradicate or virtually eradicate barred owls there before moving to more southerly areas.
- d. Barred owl numbers may increase to levels that will require significant effort in the central and southern Sierra as well if removals in the Northern Sierra are delayed or minimally successful
- e. Information on pace and scale of barred owl expansion in the Pacific Northwest could be used to inform spatial and temporal strategies for removals in the Sierra Nevada.

## 3. Barred owl Monitoring

3.1 Success of barred owl management should be monitored and management implementation should be adapted based on results. See monitoring section below.

## C2. Minimize Risk to CSO posed by disease, parasites, and contaminants

Little information exists on disease prevalence in spotted owl populations, and no information exists regarding the effects of disease on individual fitness or population viability (Assessment). There is no evidence to indicate that West Nile Virus (WNV) has significantly impacted California spotted owl populations to date (Assessment), though it may pose a threat in the future. Rodenticides pose a significant emerging threat to California spotted owls, though no information is available at this time to evaluate the magnitude and demographic consequences of this threat (Assessment). High exposure rates recently recorded in barred owls in an area where they are sympatric with spotted owls indicates that spotted owls likely have experienced high exposure rates given broad dietary overlap between the species.

Increase understanding of effects of disease and contaminants on CSO fitness.
 (Objective 1A)

What information from rodenticide exposure/effects on barred owls and pacific fisher can inform CSO conservation?

D. Foster Climate Adaptation to facilitate long-term conservation *To be developed* 

